



12th QUARTERLY REPORT - PUBLIC PAGE
DTPH56-14-H-00002
"Full Scale Testing of Interactive Features for Improved Models"

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1.0 Results and Conclusions

Task 2: Material Selection, Acquisition, and Characterization

BMT Fleet Technology completed material characterization on a 20 inch diameter, 0.281 inch wall thickness, Grade X-52, 1970's vintage pipe (Pipe F). Tensile properties were measured in both the longitudinal and transverse orientation; and base material Charpy tests were performed on specimens in transverse orientation. Half size specimens were machined following guidelines in CSA 245.1-07.

Task 3: Baseline Existing Features

Laser scan of corrosion features on Pipe F was carried out by Creaform. The laser scan data was evaluated and categorized into four different bins of 10%, 20%, 30% and 40% wall thickness reduction. The corrosion data was then used to identify pipe test segments for dents interacting with corrosion features.

Task 4: Full Scale Testing of Complex Dents

Twenty full scale dent fatigue tests in total have been carried out on Pipe D (24 inch OD, 0.375 inch wall thickness, Grade X-70) and Pipe F (20 inch OD, 0.281 inch wall thickness, Grade X-52). Four inch round bar (short and long) indenters, 12 inch and 24 inch semi-elliptical indenters have been used to create dents. Fatigue tests were carried out on plain dents, dents interacting with girth weld, dents interacting with long seam and corrosion features. Testing conditions for dents interacting with welds were the same as for the plain dents to determine the fatigue life reduction due to dent weld interaction. Similarly, testing conditions for dent interacting with corrosion features were the same as for plain dents to determine fatigue life reduction due to corrosion features.

The test data recorded for the full scale tests includes indenter travel and force required to create the dents, strains, indentation and cyclic pressure loading, dent profile and number of cycles to failure (leak).

Task 5a: Dent and Gouge Severity

Detailed defect creation data was recorded for a series of defects. The first defect was a dent and gouge referenced 6.6.3 and the second defect was a dent and gouge referenced 6.6.2a. Longitudinal and circumferential profiles were provided, as well as, 3D mapping of the defect as performed with a Seikowave scanner.

Task 5b: Interaction between Defects

Defect interaction was investigated by testing different distances between dent and gouge defects: one defect pair was adjacent, and the other one was separated by one diameter, i.e. 24 inch.

Task 5c: Dent and Gouge Defects Removed from Service

Because the fatigue test with cathodic overprotection on Defect 8.ext2.3cp did not result in a failure, the team is preparing a proposal to extend the testing with more severe conditions. The proposal will be submitted to the team and Technical Advisory team.

Task 6: SCC Colonies and SDO Modeling Coordination

After fatigue test in air (phase 0 of liquids loading protocol), vessels SCC1a, SCC1b and SCC1c were scanned by the JENTEK sensor. Results show that defect depths increased during fatigue cycling (depth propagation from 0.1mm to 0.7mm, **Error! Reference source not found.**).

Phase 1 of oil / liquids loading protocol was started. Each week, defects are scanned by JENTEK sensors to measure crack propagation and the real crack colony is checked by MPI to trace crack coalescence.

Task 7: Finite Element Analysis of Longitudinal Strain

Finite element modeling is being carried out to evaluate the effect of longitudinal strains on dent fatigue life. The table below lists the variables that have been included in the finite element modeling matrix.

Finite element modeling was carried out to evaluate the effect of longitudinal strains on dent fatigue life. **Error! Reference source not found.** lists the variables that were included in the finite element modeling matrix. The results are currently being evaluated and will be reported in the next quarter.

Pipe OD	18", 24", 30"
Pipe WT	0.25"
Pipe Grade	X-52, X-70
Indenter Size	4", 12"
Restraint Condition	Unrestrained and Restrained
Longitudinal Strain	Several cases in Tension and Compression

Task 8: Dissemination of Results

The team has completed the following in the dissemination of the results.

- The project team held monthly internal meetings with the Technical Advisory Committee (TAC).

Task 9: Project Management and Reporting

The team has completed the following project management and reporting sub-tasks:

- The project team held regular teleconference meetings to track performance, schedule and budget.
- The project team completed and submitted the required monthly and quarterly reports.

1.1 Problems, Technical Issues or Major Developments

Task 4, Full Scale testing is behind schedule.

2.0 Plans for Future Activity

Over the next 30-60 days, the following activities will be conducted:

Task 4: Full Scale Testing of Complex Dents

Full Scale testing of the dents will be continued that includes the dents interacting with corrosion features.

Task 5a: Dent and Gouge Severity

Continue processing and report of strain gauges measurements in the different tests.

Fatigue tests of dent and gouge defect 6.6.3 and of dent and gouge defect under combined loading with four-point bending will be restarted under more severe conditions in order to reach failure. The more severe loading conditions will be submitted to the Technical Advisory Board before proceeding.

Task 5c: Dent and Gouge Defects Removed from Service

The team will discuss and potentially approve the extension of the fatigue test with cathodic overprotection on Defect 8.ext2.3cp and continue testing.

Task 6: SCC Colonies and SDO Modeling Coordination

- Pursue phase 1 of oil loading protocol.
- Gas condition protocol will be discussed considering first results of oil loading test.
- Machine EDM notches on pipes SCC2a, SCC2b and SCC2c for the gas loading protocol
- Manufacture electrochemical cells for gas loading protocol

Task 7: Finite Element Analysis of Longitudinal Strain

Finite element modeling results will be analyzed and evaluated to determine the effect of longitudinal strains on dent fatigue life.